Pulsed Replenishment of Water Properties and Dissolved Oxygen in Hylebos Waterway, Tacoma, Washington

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Abstract
An extensive study of the circulation and water replenishment characteristics of Hylebos Waterway, located within the Port of Tacoma, Washington, was conducted as part of an overall study of the quantity, location, and influence of wood debris in the head of the waterway. A combination of current, water property, water quality, and meteorological measurements, along with information on ship movements provided extensive insight into the temporal and spatial variations in the water properties, and in particular dissolved oxygen conditions, along the waterway. We discovered the waterway has a flushing and replenishment system not seen previously elsewhere in Puget Sound so clearly.

Circulation and water replenishment in the head of the waterway occurs on a pulsed rather than a continuous basis. Pulse rates of the arrival to the head of the waterway of batches of replenishment water occurred at approximately three to five day intervals, between which occurred periods of stagnation. This pulsed nature of the circulation appeared to be driven by a complex combination of spring vs. neap tides, thickness of the freshwater lens from the Puyallup River when it lay off the mouth of the waterway, freshwater thickness directly entering the head of the waterway, and the density structure of the waterway's old water. The pulsed nature of the circulation occurred in all seasons, though seasonal variations in its strength were evident. Newly arriving marine water traveled along the waterway bed and displaced old water upward when entering the head, from which the old water began its travel seaward towards Commencement Bay.

Understanding the circulation and water replenishment proved critical to understanding the sources, sinks, and use rates of dissolved oxygen within this system, which allowed the true effects of wood debris upon dissolved oxygen within the water column to be understood properly.